

Montmorillonite, Oligonucleotides, RNA And Origin Of Life

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Na-montmorillonite catalyzes the self-condensation of 5'-phosphorimidazolidine derivative of adenosine, ImpA. Oligo(A)s formed in this reaction are 10 monomer units long and contain 67% 3',5'-phosphodiester bonds. Under the same reaction conditions, ImpC, ImpU and ImpG also undergo condensation producing oligomers containing up to 12-14 monomer units for oligo(C)s to 6 monomer units for oligo(G)s. In oligo(C)s and oligo(U)s, 75-80% of the monomers are linked by 2',5'-phosphodiester bonds.

Hexamer and higher oligomers isolated from synthetic oligo(C)s, which contain both 3',5'- and 2',5'-linkages, serve as catalysts for the non-enzymatic template directed synthesis of oligo(G)s from activated monomer 2-MeImpG. Pentamer and higher oligomers containing exclusively 2',5'-linkages, which were isolated from the synthetic oligo(C)s, also serve as templates and produce oligo(G)s with both 2',5'- and 3',5'-phosphodiester bonds.

A decameric primer, dA(pdA)₈pApA bound to montmorillonite was elongated to contain up to 50 monomer units by daily addition of ImpA to the reaction mixture.

Analysis of dimer fractions formed in the montmorillonite catalyzed reaction of binary and quaternary mixtures of ImpA, ImpC, 2-MeImpG and ImpU suggested that only a limited number of oligomers could have formed on the primitive Earth rather than equal amounts of all possible isomers.

Formation of phosphodiester bonds by montmorillonite catalysis is a fascinating discovery, and a significant step forward in efforts to find out how the first RNA-like oligomers might have formed in the course of chemical evolution. However, as has been pointed out in several

publications, these systems should be regarded as models rather than a literal representation of prebiotic chemistry.